

### ***In the Specification***

1. Please replace the heading "Disclosure of the Invention" on page 2 with the following amended heading:

#### **Summary of the Invention**

2. Please replace the fourth paragraph on page 2 with the following amended paragraph:

As described in detail below, a first aspect of the invention is a method of setting up the timing for the modulators of a QKD system. A two-way QKD system is considered for the sake of illustration. For a two-way QKD system, the method includes selecting an initial timing, an initial modulation voltage and a relatively large initial modulator voltage signal width for one of the modulators—say, Bob's modulator. The method also includes sending delayed non-quantum pulses from Bob to Alice and receiving the pulses back at Bob without any modulation at Alice's modulator MA. The method further includes counting the pulses that are to be modulated by Bob at Bob's detectors. If no modulation by Bob's modulator occurs, then the method includes iteratively incrementing the modulator activation signal timing by a coarse time interval and observing whether the detectors indicate that modulation has occurred. When modulation occurs, as indicated by a shift in the counts between the detectors, then the voltage timing is reset to a time that yields the change in detector counts. The coarse time interval is then sub-divided into fine time intervals. The modulator activation signal width is reduced, and the timing is adjusted by increments of the fine time interval to further narrow down the precise activation signal timing. This process of iteratively resetting the timing, subdividing the previous time intervals and then incrementing the timing by the new sub-interval is repeated until the final modulator voltage timing T1F is deduced to a desired degree of accuracy. The activation signal timing may ultimately be adjusted along the way to center the modulator activation signal to the arrival of the pulse to be modulated.

3. Please replace the heading "Detailed Description of the Best Mode of the Invention" near the bottom of page 3 with the following amended heading:

### **Detailed Description of the Invention**

4. Please replace the first paragraph on page 8 with the following amended paragraph:

In 206, controller 50 also directs voltage controller 44 to make the width W1 of the modulator activation signal V1 ~~to~~ relatively large --say, 50ns -- as compared to the final activation signal width, which is typically in the range from 2ns to 10ns. This relatively coarse width is called W1C. In 208, controller 50 selects an initial modulator voltage time T01, at which time activation signal  $V_B[\pi]$  is to be applied to modulator MB. In an example embodiment, T01 = 0.

5. Please replace the second full paragraph on page 10 with the following amended paragraph:

Once the shift in photon counts from one detector to the other occurs so that the outgoing (coarse) activation signal timing T1C is identified, then the process proceeds to 216, wherein the activation signal timing is actually set to T1C. However, the modulation timing at this point is only known to within the timing interval  $\Delta T1$ , which is ~~initial~~ initially set to a relatively large value, e.g., 50ns.

6. Please replace the third full paragraph on page 10 with the following amended paragraph:

The relatively coarse modulation activation signal width W1C needs to be decreased to a more reasonable value W1R. Ideally, activation signal V1 =  $V_B$  ultimately has a final width W1F that is as small as possible so that modulator MB is activated only for the briefest amount of time necessary to modulate incoming pulse

P1. Also, the final activation signal width  $W1 = \cancel{WB} \underline{W1F}$  needs to be small enough so that incoming pulse P2, which is close to incoming pulse P1 (e.g., within a few nanoseconds), passes through modulator MB without being modulated.

7. Please replace the first full paragraph under the heading "Timing for Alice's modulator" on page 11 with the following amended paragraph:

Accordingly, with continuing reference to FIG. 1 and also to the flow diagram 300 of FIG. 3B 3, in 302 Bob's modulator voltage is set constant at  $V1 = V_B[\pi]$ .

8. Please replace the third full paragraph on page 13 with the following amended paragraph:

Then, as in 218 of Bob, in 318 the timing interval  $\Delta T2$  is divided into finer (reduced) sub-intervals  $\Delta T2R$  and in 322 acts 312-317 are repeated. If a change occurs in the photon count that indicates a change back to the "no modulation" state, then in 324, as in 224 for Bob, the modulator voltage timing  $T2R$  is adjusted to shift the narrowed voltage signal until modulation is reestablished, and preferably so the narrowed voltage signal is centered on the pulse P2. In 326, acts 317-324 (or 318-324) are then repeated until final desired activation signal timing  $T2F$  is established, along with a final desired activation signal width  $\cancel{WF} \underline{W2F}$ . In an example embodiment, Alice's final activation signal width  $W2F$  is about 5X of Bob's activation signal  $W1F$ , e.g.,  $W1F = 2\text{ns}$  and  $W2F = 10\text{ns}$ .

9. Please add the following new paragraph as the last paragraph in the "Detailed Description of the Invention" section after the last paragraph on page 14 and immediately prior to the claims section:

In the foregoing Detailed Description, various features are grouped together in various example embodiments for ease of understanding. The many features and advantages of the present invention are apparent from the detailed specification, and, thus, it is intended by the appended claims to cover all such features and

advantages of the described apparatus that follow the true spirit and scope of the invention. Furthermore, since numerous modifications and changes will readily occur to those of skill in the art, it is not desired to limit the invention to the exact construction, operation and example embodiments described herein. Accordingly, other embodiments are within the scope of the appended claims.